THE METRIC SYSTEM.

In the current issue of Science (March 4) Mr. Alfred C. Lane has presented some useful hints with a view to facilitating the popular adoption of the metric system in America. His chief points are the adoption of the metric ton as the standard of mass, the definition of the standard pint as the volume of a half-kilogram of water under standard conditions, and the definition of the foot as the length of the edge of a cube whose capacity is 62.5 pints. This last definition is said, in an appended note, to be not essential to the scheme.

In any system of metrology the unit of length is that to which all other units are finally referred, unless these are so arbitrary as to preclude the use of the word 'system.' The essentials of any desirable system are simplicity and consistency. An ideal system is that developed a century ago in France and now employed by all scientific workers, but not yet popular with the masses in English-speaking countries. The problem of conferring popularity upon it is one that will require many years yet for its solution.

Whatever may be the form taken by legislation in England and the United States, the people can not be compelled to adopt nomenclature that is thrust upon them as a substitute for that to which they have always been accustomed. The nomenclature must be simple in order to secure adoption; it must be at least fairly in harmony with old customs in order to win favor. For many centuries past the foot has been by far the most popular unit of length, though the range of variation in its value has been 165 per cent. of the smallest magnitude to which the name was applied. In like manner the pound has been the popular unit of weight, with as many as 235 variations in value. The use of these names in different languages is popularly maintained, even in countries, like France and Germany, where the metric system is legally established.

If the metric system is ever to become popular in the United States it must be through the medium of such legislation as will give us its substance with as little as possible of its nomenclature. Its essential features are:

1. A decimal relation between all the units employed.

2. A direct and simple relation between units of length and mass.

In view of the strong influence of old customs we can not expect a new system to be inaugurated that is exclusively decimal. If the people are accustomed to binary or duodecimal subdivision they will hold to it in spite of legislation. All of us are disposed to do what we find easiest. Nor is there much reason to expect that all units of length and mass will be discarded except those connected by the simplest relation. Ideas may differ as to what is simplest, and in any case there will be a survival of what the populace finds fittest, irrespective of the prescriptions of theory. The introduction of the metric system can be accomplished only by some sort of compromise, through which old names may be retained while the values of the corresponding magnitudes are slightly modified for the sake of simplicity.

Everybody understands that by a process of selection the once chaotic British system has been becoming simpler. Many units that were in use a half century ago are now obsolete, though the inconvenient relation between those still surviving is bad enough and incapable of much improvement. By still further excision, by adoption of a few names and values from the metric system, and by such modification in existing values as will produce no great inconvenience, we may quite reasonably hope for such practical adoption of a decimal system as to

satisfy all the demands of international commerce.

It should be remembered that by act of congress, April 5, 1893, the international standard meter and kilogram were adopted as the standards of length and mass, respectively, for the United States. The yard and the pound are now legally defined as merely definite fractions of the meter and the kilogram. The following outline of an American system of metrology has occurred to me as perhaps capable of adoption. Some, if not all, of its features must have occurred to many of the advocates of metric reform.

1. Let the length of the yard be changed by legal enactment so as to coincide with that of the standard meter.

2. Let the foot be defined as the fourth part, instead of the third, of a yard. Let it be divided into ten instead of twelve inches. The length of the inch will thus be changed by less than two per cent.

3. Let the pound be defined legally as one half of a kilogram.

4. Let the quart be defined legally as the volume of a kilogram of water under the usual standard conditions. The quart and the liter become thus identified.

5. Let the ton be defined as 1,000 kilograms. The American and metric tons are thus identified.

6. Let the pint, gallon, peck and bushel be retained as secondary units, each being defined in terms of the quart.

The latter part of this scheme, it will be observed, is identical with a part of that proposed by Mr. Lane, but the first part differs quite radically from his. The following tabulation constitutes a summary for measures of length, mass and capacity, respectively.

UNITS OF LENGTH.

1 meter	= 1 yard	= 100	centimeters	= 1,000	millimeters.
1 inch	= 1/40 yard	= 2.5	"	= 25	"
1 foot	= 10 inches	= 25	"		

UNITS OF MASS.

1 kilogram	= 1,000	grams.	
1 pound	= ½	kilogram	= 500 grams.
1 ton	= 1,000	kilograms	= 2,000 pounds.

UNITS OF CAPACITY.

1 liter	= 1	quart	= volume of	1	kilogram	of	water.
1 pint	= ½	"	= "	"	1	pound	"	"
1 gallon	= 4	quarts	= "	"	8	pounds	"	"
1 peck	= 8	"	= "	"	16	"	"	"
1 bushel	= 32	"	= "	"	64	"	"	"

This table includes about all of the units needed for most of our measurement. Units of area and volume need no definition. For land measure the mile as unit of length and the acre as unit of area will probably last many years yet. They have no place in international commerce, the needs of which constitute the most important ground for changing the units hitherto in use. No mere theoretic consideration will be apt to influence legislation.

The scheme just outlined presents the advantages of both the decimal and the binary systems of subdivision. In practise halves and quarters are much the most important of the binary subdivisions. In our decimal system of American money the only sudivisions of the dollar that now survive are the half, quarter, tenth, twentieth and hundredth; though eighths and sixteenths seem to have been once coined, and were found more confusing than useful. The division of the foot into tenths rather than twelfths is in accordance with custom now well established among engineers and surveyors. The binary subdivision of the inch may be retained as long as found useful, while the centimeter will be divided into both halves and tenths.

It will be noticed that while some of the secondary British units are retained, especially those with binary relation to the primary unit, the ounce, dram, pennyweight, scruple and grain are all discarded. There has been but little use for these outside of the pharmacy and the mint. The retail dealer uses halves and quarters of a pound. All educated pharmacists to-day

have learned the metric system. They need no weights but the gram with its decimal multiples and divisions. The ounce ought long ago to have been abolished or defined as a definite fraction of the avoirdupois pound alone. Its abolition is much preferable to its retention.

An obvious advantage of dividing the foot into 10 inches is that a cubic foot becomes 1,000 instead of 1,728 cubic inches. The weight of the cubic foot of water becomes 31.25 pounds according to the suggested definition of the pound. The reduction in length to 10 inches, furthermore, makes it coincide very closely with the length of the average masculine foot, while 12 inches is more than twenty per cent. too long.

The suggested length of the inch is between one per cent. and two per cent. less than that of the present inch. Small as this change may be, it constitutes the most serious of all the changes suggested. The practical standard of length in the United States has been, not the yard or foot, but the inch. In the construction and use of all machinery inches and fractions of an inch are the units of measurement. If a screw-thread has been cut in accordance with a gauge based on the inch, a change of two per cent. in the inch would render such a screw worthless for the same machine. The mechanical engineers and machine manufacturers will, therefore, continue to be the most determined enemies of metric reform. Should legislation be adopted involving a change of standards, a generous allowance of time ought to be provided, within which the machinists may adapt new instruments to the new standards. Few, if any, machines can be expected to continue available more than ten years. Such a period of grace would, perhaps, be as much as could be reasonably demanded.

The pound equal to half a kilogram is about one tenth greater than the avoirdupois pound. It is identical with the German *pfund* and the French *livre*. Its adoption by England and the United States would make the pound a definite unit readily understood throughout most of the civilized world. It is now indefinite.

Assigning the qualifier 'metric' to the proposed units to distinguish them from the old ones now in use in the United States, their mutual relations are approximately shown in the following table:

1	metric	yard	= 1.0936	old	yard.
1	"	foot	= 0.8202	"	foot.
1	"	inch	= 0.9842	"	inch.
1	"	pound	= 1.1023	"	pound.
1	"	ton	= 0.9845	"	long ton.
1	"	quart	= 1.0567	"	wine quart.
1	"	pint	= 1.0567	"	wine pint.
1	"	gallon	= 1.0567	"	wine gallon.
1	"	peck	= 0.9081	"	peck.
1	"	bushel	= 0.9081	"	bushel.

It is, of course, understood that the proposer of any change whatever in the units to which the American public is accustomed will be adversely criticized, particularly by the mechanical engineers and the manufacturers of machine tools. Such criticism can be borne with equanimity if the compromise scheme just outlined should lead to the practical adoption of the metric standards and the decimal system of weights and measures, with a reasonable combination of the binary system with it. The decimal system of coinage a century ago was regarded by some critics as visionary, but it has stood the test of time.

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THE AUSTRALASIAN ASSOCIATION.

The biennial meeting of the Australasian Association for the Advancement of Science was held this year at Dunedin, New Zealand. There was a large attendance of members from all the Australasian colonies